CLAIMS

1. A method of manufacturing a circuit board comprising the steps of:

(a) preparing a film-coated board material by bonding a film material to at least one of a surface of said board material and a back surface of said board;

(b) forming at least one hole of a through-hole and a non-through-hole, in said film-coated board material,

wherein unnecessary material is produced when said hole is formed and said unnecessary material sticks to said board material, and

said unnecessary material has at least one selected from the group consisting of affected portion, affected material and foreign matter which are generated from said board material;

(c) selectively removing said unnecessary material sticking to said film-coated board material without peeling said film material off said board material;

(d) disposing a conductive material in said hole formed in said film-coated board material, using said film material as a mask; and

(e) removing said film material from said film-coated board material having said conductive material.

2. The method of manufacturing a circuit board as defined

in claim 1,

wherein the process for forming said hole includes a process of forming said hole by applying a laser beam, and

the application of said laser beam causes generation of said unnecessary material.

3. The method of manufacturing a circuit board as defined in claim 2, further comprising a step of:

(f) installing a metallic foil pattern wiring on at least one of the surface and back surface of said board material having said conductive material,

wherein said metallic foil pattern wiring is conductive to said conductive material.

4. The method of manufacturing a circuit board as defined in claim 2,

wherein said film material is disposed on both the surface and back of said board material, and

said hole is a through-hole that goes through the surface and the back of said film-coated board material.

5. The method of manufacturing a circuit board as defined in claim 4, further comprising a step of:

(f) installing a first metallic foil pattern wiring on the surface of said board material having said conductive material

and installing a second metallic foil pattern wiring on the back of said board material having said conductive material,

wherein said first metallic foil pattern wiring and said second metallic foil pattern wiring are conductive to said conductive material.

6. The method of manufacturing a circuit board as defined in claim 2,

wherein the step of selectively removing said unnecessary material sticking to said film-coated board material from said film-coated board material includes a process for selectively removing said unnecessary material from said film-coated board material by the vibrational energy generated by said supersonic oscillator while immersing said film-coated board material in a cleaning tank having a cleaning solution and supersonic oscillator.

7. The method of manufacturing a circuit board as defined in claim 2,

wherein the step of selectively removing said unnecessary material sticking to said film-coated board material from said film-coated board material includes a process for selectively removing said unnecessary material from said film-coated board material by the vibrational energy generated by said supersonic oscillator while immersing said

film-coated board material in a cleaning tank having a cleaning solution and supersonic oscillator, and

a flow of said cleaning solution is created between said supersonic oscillator and said film-coated board material, and said film-coated board material is subjected to supersonic cleaning while the flow of said cleaning solution is applied to said board material.

8. The method of manufacturing a circuit board as defined in claim 2,

wherein the step of selectively removing said unnecessary material sticking to said film-coated board material from said film-coated board material includes

(i) a process for selectively removing said unnecessary material from said film-coated board material by the vibrational energy generated by said supersonic oscillator while immersing said film-coated board material in a cleaning tank having a cleaning solution and supersonic oscillator;

(ii) a process for taking said film-coated board material out of said cleaning tank after removing said unnecessary material; and

(iii) a process for removing at least one of remaining unnecessary material and cleaning solution sticking to said film-coated board material by blowing a gas to said film-coated board material taken out of said cleaning tank;

wherein a flow of said cleaning solution is created between said supersonic oscillator and said film-coated board material, and

said film-coated board material is subjected to supersonic cleaning while the flow is applied to said board material.

9. The method of manufacturing a circuit board as defined in claim 2,

wherein the step of selectively removing said unnecessary material sticking to said film-coated board material from said film-coated board material includes a process for selectively removing said unnecessary material from said film-coated board material by the vibrational energy generated by said supersonic oscillator while immersing said film-coated board material in a cleaning tank having a cleaning solution and supersonic oscillator, and

said film-coated board material is subjected to supersonic cleaning, in a state such that a plate is disposed between said supersonic oscillator and said film-coated board material, and

said plate serves to control the volume of supersonic energy that reaches said film-coated board material.

10. The method of manufacturing a circuit board as defined

in claim 2,

wherein the step of selectively removing said unnecessary material sticking to said film-coated board material from said film-coated board material includes

(i) a process for selectively removing said unnecessary material from said film-coated board material by the vibrational energy generated by said supersonic oscillator while immersing said film-coated board material in a cleaning tank having a cleaning solution and supersonic oscillator;

(ii) a process for taking said film-coated board material out of said cleaning tank after removing said unnecessary material; and

(iii) a process for removing at least one of remaining unnecessary material and cleaning solution sticking to said film-coated board material by blowing a gas to said film-coated board material taken out of said cleaning tank;

wherein said film-coated board material is subjected to supersonic cleaning, in a state such that a plate is disposed between said supersonic oscillator and said film-coated board material, and

wherein said plate serves to control the volume of supersonic energy that reaches said film-coated board material.

11. The method of manufacturing a circuit board as defined in claim 2,

wherein the step of selectively removing said unnecessary material sticking to said film-coated board material from said film-coated board material includes a process for selectively removing said unnecessary material from said film-coated board material by the vibrational energy generated by said supersonic oscillator while immersing said film-coated board material in a cleaning tank having a cleaning solution and supersonic oscillator, and

wherein said film-coated board material is subjected to supersonic cleaning in a state such that said film-coated board material is held on both sides by plates.

12. The method of manufacturing a circuit board as defined in claim 2,

wherein the step of selectively removing said unnecessary material sticking to said film-coated board material from said film-coated board material includes a process for selectively removing said unnecessary material from said film-coated board material by the vibrational energy generated by said supersonic oscillator while immersing said film-coated board material in a cleaning tank having a cleaning solution and supersonic oscillator, and

wherein said film-coated board material is subjected to supersonic cleaning in a state such that a plate material is bonded to one side of said film-coated board material.

13. The method of manufacturing a circuit board as defined in claim 2,

wherein the process for selectively removing said unnecessary material sticking to said film-coated board material from said film-coated board material includes

(i) a process for selectively removing said unnecessary material from said film-coated board material by the vibrational energy generated by said supersonic oscillator while immersing said film-coated board material in a cleaning tank having a cleaning solution and supersonic oscillator;

(ii) a process for taking said film-coated board material out of said cleaning tank after removing said unnecessary material; and

(iii) a process for removing at least one of remaining unnecessary material and cleaning solution sticking to said film-coated board material by blowing a gas to said film-coated board material taken out of said cleaning tank; and

wherein said film-coated board material is subjected to supersonic cleaning in at least one state of (a)such that said film-coated board material is held on both sides by plates and (b) such that a plate is bonded to one side of said film-coated board material.

14. The method of manufacturing a circuit board as defined

in claim 7, wherein the flow of said cleaning solution is generated by a discharge device having a discharge port and pump.

15. The method of manufacturing a circuit board as defined in claim 7, wherein the flow of said cleaning solution is circulated by the cleaning solution discharged from a slit type discharge port.

16. The method of manufacturing a circuit board as defined in claim 7, wherein the flow of said cleaning solution is circulated by the cleaning solution discharged from a shower type discharge port.

17. The method of manufacturing a circuit board as defined in claim 7, wherein the flow of said cleaning solution is circulated by the cleaning solution discharged from a plurality of discharge ports.

18. The method of manufacturing a circuit board as defined in claim 9, wherein said plate has a flat plate.

19. The method of manufacturing a circuit board as defined in claim 9, wherein said plate has a corrugated plate.

20. The method of manufacturing a circuit board as defined in claim 9,

wherein said plate has at least one of a flat plate and a corrugated plate, and

said plate has at least a hole whose diameter is less in wavelength than 1/4 of a standing wave.

21. The method of manufacturing a circuit board as defined in claim 9, wherein said plate includes metal.

22. The method of manufacturing a circuit board as defined in claim 9, wherein said plate includes a plurality of metal thin plates.

23. The method of manufacturing a circuit board as defined in claim 13, wherein said plate internally has at least one of an air layer and bubbles.

24. The method of manufacturing a circuit board as defined in claim 13,

wherein the step of selectively removing said unnecessary material sticking to said film-coated board material from said film-coated board material further includes a process of moistening said film-coated board material with said cleaning solution before said film-coated board material

is held on both sides by said plates.

25. The method of manufacturing a circuit board as defined in claim 6, wherein said supersonic oscillator generates a sound pressure of 9.55×10^{10} μPa or over.

26. The method of manufacturing a circuit board as defined in claim 6,

wherein at the process for selectively removing said unnecessary material sticking to said film-coated board material from said film-coated board material, said film-coated board material is subjected to supersonic cleaning in a state such that a plate is disposed between said film-coated board material and said supersonic oscillator, and

the sound pressure that reaches said film-coated board material due to said plate material ranges from 4.78×10^{10} μPa to 9.55×10^{10} μPa.

27. The method of manufacturing a circuit board as defined in claim 2,

wherein the step of selectively removing said unnecessary material sticking to said film-coated board material from said film-coated board material without peeling said film material from said board material includes

(i) a process for selectively removing said unnecessary

material from said film-coated board material while immersing said film-coated board material in a cleaning tank having a cleaning solution;

(ii) a process for taking said film-coated board material out of said cleaning tank after removing said unnecessary material; and

(iii) a process for removing at least one of remaining unnecessary material and cleaning solution sticking to said film-coated board material taken out of said cleaning tank;

wherein said film-coated board material is heated in at least one of the above process (i) and process (iii).

28 The method of manufacturing a circuit board as defined in claim 27,

wherein the step of removing at least one of remaining unnecessary material and cleaning solution sticking to said film-coated board material taken out of said cleaning tank includes at least one of (a) a blowing process using a blow gas and (b) a mechanical cleaning process using a rotary brush in order to remove said unnecessary material and cleaning solution remaining on said film-coated board material.

29. The method of manufacturing a circuit board as defined in claim 2 further comprising a step of:

preheating said film-coated board material prior to the

step of selectively removing said unnecessary material sticking to said film-coated board material from said film-coated board material without peeling said film material from said board material.

30. The method of manufacturing a circuit board as defined in claim 6, further comprising a step of:

preheating said film-coated board material prior to the step of selectively removing said unnecessary material sticking to said film-coated board material from said film-coated board material without peeling said film material from said board material.

31. The method of manufacturing a circuit board as defined in claim 27,

wherein the step of selectively removing said unnecessary material sticking to said film-coated board material from said film-coated board material without peeling said film material from said board material further includes a process of preheating said film-coated board material prior to at least one selected from the group consisting of said cleaning process, said blowing process and said mechanical cleaning process.

32. The method of manufacturing a circuit board as defined

in claim 2, wherein said cleaning solution is heated up to a temperature higher than the normal temperature.

33. The method of manufacturing a circuit board as defined in claim 6, wherein said cleaning solution is heated up to a temperature higher than the normal temperature.

34. The method of manufacturing a circuit board as defined in claim 27, wherein said cleaning solution is heated up to a temperature higher than the normal temperature.

35. The method of manufacturing a circuit board as defined in claim 8, wherein said gas is heated.

36. The method of manufacturing a circuit board as defined in claim 10, wherein said gas is heated.

37. The method of manufacturing a circuit board as defined in claim 13, wherein said gas is heated.

38. The method of manufacturing a circuit board as defined in claim 27,

wherein the heating temperature of said film-coated board material ranges from the temperature at which said film material is not peeled off said film-coated board material due

to stresses to the temperature of heat resistance and the temperature of desired physical property change of said board material and said film material.

39. The method of manufacturing a circuit board as defined in claim 2,

wherein said board material includes a reinforcement and thermosetting resin impregnated with said reinforcement, and

said board material includes prepreg of B stage.

40. The method of manufacturing a circuit board as defined in claim 39, wherein said reinforcement includes at least one of a woven cloth and a non-woven cloth made up of glass fiber.

41. The method of manufacturing a circuit board as defined in claim 39, wherein said reinforcement includes at least one of a woven cloth or non-woven cloth made up of aromatic polyamide fiber.

42. The method of manufacturing a circuit board as defined in claim 2, wherein said cleaning solution includes at least one of a water and a refined pure water.

43. The method of manufacturing a circuit board as defined in claim 27, wherein said cleaning solution includes organic

solvents.

44. The method of manufacturing a circuit board as defined in claim 2, wherein the step of disposing said conductive material in said hole includes a process of filling a conductive paste into said hole.

45. The method of manufacturing a circuit board as defined in claim 2, wherein the step of disposing said conductive material in said hole includes a process of performing conductive plating in said hole.

46. The method of manufacturing a circuit board as defined in claim 6,

wherein the step of selectively removing said unnecessary material sticking to said film-coated board material from said film-coated board material without peeling said film material from said board material includes a process for removing said unnecessary material from said film-coated board material by the vibrational energy generated by said supersonic oscillator while said film-coated board material retained by a carrying member having an area at least equivalent to that of said board material is moved at a predetermined distance from said supersonic oscillator.

47. The method of manufacturing a circuit board as defined in claim 6,

wherein the step of selectively removing said unnecessary material sticking to said film-coated board material from said film-coated board material without peeling said film material from said board material includes a process of removing said unnecessary material from said film-coated board material by the vibrational energy generated by said supersonic oscillator while said hole is positioned above said supersonic oscillator.

48. The method of manufacturing a circuit board as defined in claim 3, wherein a multilayer wiring board is prepared by laminating a plurality of said board materials having said metallic foil wiring patterns.

49. The method of manufacturing a circuit board as defined in claim 2, wherein said film material includes a thermosetting resin layer on at least one of one side and both sides of the film material.

50. A cleaning device to remove an unnecessary material from a film-coated board material to which the unnecessary material is sticking, wherein said film-coated board material comprises a board material and a film material as a mask bonded

to said board material, said film material is bonded to said board material in a manner such that it can be removed from said film-coated board material, said unnecessary material is produced when a hole is formed in said film-coated board material, and said unnecessary material is sticking to said film-coated board material,

said cleaning device comprises

a cleaning tank;

a cleaning solution provided in said cleaning tank;

a supersonic oscillator installed in said cleaning solution;

a feeding device which feeds said film-coated board material into said cleaning solution while retaining said film-coated board material; and

a selective removing means which selectively removes said unnecessary material from said film-coated board material without peeling said film material;

wherein said selective removing means includes at least one selected from the group consisting of

(i) a water flow generator which generates a water flow between said supersonic oscillator and said film-coated board material located above said supersonic oscillator;

(ii) a diffusing plate installed between said supersonic oscillator and said film-coated board material located above said supersonic oscillator; and

(iii) resonance control plates which hold said film-coated board material therebetween.

51. The cleaning device as defined in claim 50,

wherein said film-coated board material retained by said feeding device passes over the supersonic oscillator at a predetermined distance therefrom,

said selective removing means has said resonance control plates which hold said film-coated board material therebetween,

said carrying means also serves as said resonance control plate, and

said resonance control plate functions to control the supersonic energy generated by the supersonic oscillator.

52. The cleaning device as defined in claim 51, wherein said resonance control plate has an area at least equivalent to that of said board material.

53. The cleaning device as defined in claim 51, wherein said resonance control plate includes a plate internally having at least one of an air layer and bubbles.

54. The cleaning device as defined in claim 51,

wherein said feeding device includes upper and lower conveyors;

said upper conveyor includes a first plurality of resonance control plates;

said lower conveyor includes a second plurality of resonance control plates; and

each of said first plurality of resonance control plates and each of said second plurality of resonance control plates pass over said supersonic element while holding said film-coated board material therebetween.

55. The cleaning device as defined in claim 50,

wherein said selective removing means has said water flow generator which generates a flow of cleaning solution between said supersonic oscillator and said film-coated board material located above said supersonic oscillator.

56. The cleaning device as defined in claim 55,

wherein said water flow generator includes an submergible pump;

said submergible pump has at least one discharge port, a slit type discharge port or a shower type discharge port; and

said discharge port serves to generate a flow of cleaning solution in the direction between said supersonic oscillator and said film-coated board material.

57. The cleaning device as defined in claim 55,

wherein said water flow generator has discharge ports disposed at a plurality of portions in said cleaning tank, and

each discharge port serves to generate a flow of said cleaning solution in the predetermined direction.

58. The cleaning device as defined in claim 50,

wherein said selective removing means includes a water flow generator which generates a flow of cleaning solution between said supersonic oscillator and said film-coated board material located above said supersonic oscillator;

resonance control plates which hold said film-coated board material therebetween;

the flow of said cleaning solution has a function to diffuse at least one of cavitation and sound field generated by said supersonic oscillator, and

said resonance control plate has a function to control the supersonic energy generated by the supersonic oscillator.

59. The cleaning device as defined in claim 50,

wherein said selective removing means includes a diffusing plate disposed between said supersonic oscillator and said film-coated board material located above said supersonic oscillator; and

said diffusing plate has a function to control the sound pressure generated by said supersonic oscillator.

60. The cleaning device as defined in claim 59,

wherein said diffusing plate includes at least one selected from the group consisting of a flat plate, corrugated plate and metal plate.

61. The cleaning device as defined in claim 59, wherein said diffusing plate includes a plurality of thin plates.

62. The cleaning device as defined in claim 50, wherein said sound pressure ranges from 4.78×10^{10} μPa to 9.55×10^{10} μPa.

63. The cleaning device as defined in claim 50, further comprising:

a removing device to remove said film-coated board material from said cleaning tank after removing said unnecessary material, and

a cleaning device to remove at least one of remaining unnecessary material and cleaning solution sticking to said film-coated board material taken out of said cleaning tank.

64. The cleaning device as defined in claim 50, further comprising:

an another removing device to remove at least one of

remaining unnecessary material and cleaning solution sticking to said film-coated board material taken out of said cleaning tank,

wherein said another removing device includes at least one of

(a) a blowing device which removes said unnecessary material and said cleaning solution remaining on said film-coated board material by blowing a gas thereto, and

(b) a mechanical cleaning device using a rotary brush.

65. The cleaning device as defined in claim 50, further comprising:

a preheating device to heat said film-coated board material,

wherein said preheating device serves to heat said film-coated board material before its feeding into said cleaning solution.

66. The cleaning device as defined in claim 64, further comprising:

a preheating device to heat said film-coated board material,

wherein said preheating device serves to heat said film-coated board before its feeding into at least one of said blowing device and said mechanical cleaning device.